INTERNAL SRS PROTOCOL

Conceptual Site Model Development

Introduction

The following protocol has been developed in order to support the Savannah River Site (SRS) Environmental Restoration (ER) program. This protocol provides instructions for the development of conceptual site models (CSMs) used in the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Remedial Investigation (RI) process. This process is commonly referred to as the RFI/RI process. The protocol is intended to provide guidance promoting consistency in the presentation of CSMs provided in regulatory documents across ER project teams. A simplified CSM has been identified as in integral part of the Operating Unit (OU) summary.

The development of the CSM is an iterative process that begins during the pre-workplan investigation, sampling and analysis planning phase and is continually refined throughout the RFI/RI/Baseline Risk Assessment (BRA) process. The final CSM presented in Chapter 10 of the RI/BRA represents the understanding of the unit based on the remedial investigation data evaluation and the risk assessment calculations. The Remedial Goal Options (RGOs) presented in Chapter 11 of the RI/BRA are developed for the particular media and receptors remaining with contaminants of concern (COCs) after the refinement of COCs in Chapter 9 of the RI/BRA. These refined COCs (RCOCs) become the basis for the Feasibility Study (FS) and the contaminated media identified in the final CSM is the focus of the FS analysis. The proposed plan (PP) and record of decision (ROD) will reflect the findings of the entire process as represented by the final CSM and the FS analysis.

Initially, the CSM provides a representation of the source of contamination and how it was released into the environment based on historical information. It also includes potential release mechanisms and exposure routes based on the existing understanding of the nature and extent of contamination. In addition, potential human and ecological receptors are identified within the CSM based on the location of the unit with respect to potential authorized and unauthorized access and surrounding habitats.

The release mechanisms and exposure routes are modified as data are collected and evaluated. Within the BRA, the human health and ecological CSMs may be revised separately to identify the complete exposure pathways for the appropriate receptors and to identify pathways that will be quantitatively or qualitatively evaluated using available data. Once the BRA is completed, the human health and ecological CSMs are combined to illustrate the significant pathways and receptors that are potentially at risk.

Figure 1 provides an example of a CSM that has been prepared after initial data evaluation for a typical operable unit (OU). CSMs used to support the RFI/RI/BRA should have the following headings: Primary Source, Primary Release Mechanism, Secondary Source, Secondary Release Mechanism, Exposure Media, Exposure Route, and Potential Receptors. Each portion of the CSM is described in the sections below. An example of a focused ecological CSM prepared only for the ecological portion of the BRA is provided in Figure 2. For the human health BRA, the ecological receptors are not shown on the focused CSM and minor variations are usually made to the exposure route determinations. Therefore, an example of a focused human health CSM is not provided. Figure 3 is an example of a refined CSM that has been prepared after the constituents of concern (COCs) have been identified.

Details

Primary Source

The primary source contains a brief description of the waste(s) initially disposed within the OUs. The primary source is usually known or assessed from review of historical documentation. Some examples include: liquid discharged into a basin, debris buried in a pit, solvents spilled on the ground, liquid effluents released from an outfall, etc. If an operable unit has more than one primary source, or the areas of disposal of the primary source are being investigated independently, then separate CSMs should be prepared for each. For example, if an operable unit contains a burning rubble pit and an ash basin, then separate CSMs should be prepared for each disposal area. Similarly, a basin and it's associated pipeline should be represented on separate CSMs. Separate CSMs prepared for each primary source or source area will aid in presenting the conclusions of the BRA for the refined CSMs.

In some cases, additional primary sources may be identified by field activities associated with the sampling and analysis plan. Such discoveries will be included in subsequent CSM revisions.

Principal threat source material (PTSM) or low level threat waste (LLTW), as defined by non-quantitative risk criteria (e.g., Lead concentrations >4,000 mg/kg, PCB concentrations >50 mg/kg, total carcinogens $>10^{-3}$ risk and noncarcinogens hazard quotient [HQ] >100) should be identified under the Primary Source category, if it is known to exist at the waste unit. An example of PTSM would be a buried drum of highly toxic source material.

Primary Release Mechanism

The primary release mechanism describes how contaminants from the primary source enter the environment or impact secondary sources. Some examples include deposition directly from the primary source as in the case of a liquid release to a basin, runoff, leakage from deteriorating drums, leakage from pipeline joints, etc.

Secondary Source

The secondary source includes the environmental media contaminated by the release of the primary source. Initially, the secondary source is assumed to include soil beneath and/or adjacent to the primary source material and surface water (if appropriate). For ease of representation, the secondary sources are typically divided into exposure groups (surface soil [0-1 ft/0-0.3 m], subsurface soil [0-4 ft/0-1.2 m], deep soil [>4 ft/>1.2 m], and surface water). If direct runoff from the primary source to a surface water body is not appropriate, then surface water should not be shown as a secondary source. Additionally, the method of transport between soil exposure groups is labeled (e.g., infiltration/percolation).

Secondary Release Mechanism

Secondary release mechanisms should include processes that in the past, currently, or may in the future, release contaminants for exposure to potential receptors. Secondary release mechanisms typically used include: fugitive dust generation, volatilization, biotic uptake, radiation emissions, leaching, and excavation (usually applied to 0-4 ft soil interval). Direct contact is not considered a release mechanism (as some previously developed CSMs have shown). For direct ingestion or dermal contact with soil, the secondary release mechanism should be left blank.

Exposure Media

All media that could potentially be contaminated should be listed beneath the exposure media category. The media should be listed separately for each different exposure group (i.e., surface soil and subsurface soil should be listed separately).

Exposure Route

The exposure route identifies the method of entry into the receptor (e.g., inhalation, ingestion, dermal contact, external radiation). For the groundwater pathway, inhalation and dermal contact (both from showering) should be listed together because the risk/hazard calculations for these routes are combined in the human health risk assessment. For ecological representations, a foodweb may be developed to communicate biotransfer mechanisms for cases where groundwater is available for exposure (e.g., groundwater seeps). This can assist in focusing and selecting assessment and/or measurement endpoints.

Potential Receptors

Human and ecological receptors are identified on the same CSM, as appropriate, in the data collection work plan and early stages of the RI processes. In the BRA, however, human and ecological receptors are separately addressed for the focused CSMs. Following the completion of the BRA, the CSMs are combined again (in the summary and conclusions section of the RFI/RI/BRA) to summarize the potential risks/hazards for each receptor by exposure routes.

Human Health

For the human health CSMs, the receptor for the current exposure scenario is represented by an on-unit worker. Potential future exposure scenarios are represented by an industrial worker, an on-unit resident adult, and an on-unit resident child. Depending on the location of the waste unit with respect to the SRS boundary and access control, a current or future trespasser may also be considered as a potential receptor.

Ecological

Ecological receptors are defined as plant and animal populations and communities, habitats, and sensitive environments. (EPA, 1997). The receptors depicted in the CSM are selected based on the results of the screening-level ecological risk assessment (Steps 1 and 2 of the ecological risk assessment [ERA] process) and are further refined to establish the complete exposure pathways evaluated in the ERA based on the relationship of the contaminants to the assessment endpoints. A foodweb diagram may be developed to communicate biotransfer mechanisms associated with ecological receptors. This may also assist in refining the assessment and measurement endpoints that dictate which receptors will be presented in the CSM.

Refined CSMs

Refined CSMs presented in the summary chapter of the RFI/RI/BRA should provide a summary of the results of the risks/hazards calculated in the BRA. This summary should coincide with the symbols listed in the following section.

For the ecological component, the CSM is refined and is presented to establish the complete exposure pathways evaluated in the ERA and the relationship of the contaminants to the assessment endpoints selected. In the refined CSM, the possible exposure pathways are depicted in an exposure pathway diagram and are directly linked to the assessment endpoints.

This refinement is based on knowledge of the contaminants present, exposure pathways, and the assessment endpoints. Ecological risk questions are developed to address the questions about the relationships among assessment endpoints and their predicted responses when exposed to unit contaminants.

Symbols

For each receptor, the exposure routes quantitatively addressed in the BRA should be designated with a darkened circle. Exposure routes being addressed qualitatively should be designated with an open circle. If contact with a particular media is not anticipated for a receptor then the associated exposure route should be identified with a dash indicating that the exposure route is incomplete for that receptor. Pathways should not be marked as incomplete only because data was not collected (e.g., the pathway is being

addressed under another OU). Appropriate footnotes or visual designations should be provided for unit specific circumstances.

Other symbols as presented below are intended to provide a visual summarization of the results of the BRA. There is no significance to the symbols except to standardize them for application for each BRA.

Incomplete pathway	--
Quantitative evaluation	●
Qualitative evaluation	○
No Constituents of Potential Concerns identified (COPCs)	⌀
No final COPCs identified (applicable to ERA only)	□
No preliminary Constituents of Potential Concerns identified (pCOCs)	⊙
No refined Constituent of Concerns (COCs)	⊗
Refined COCs exist	Provide specific risk/hazard value

References

US EPA, 1997. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments.* Interim Final. Environmental Response Team, Edison, NJ, June 5, 1997.

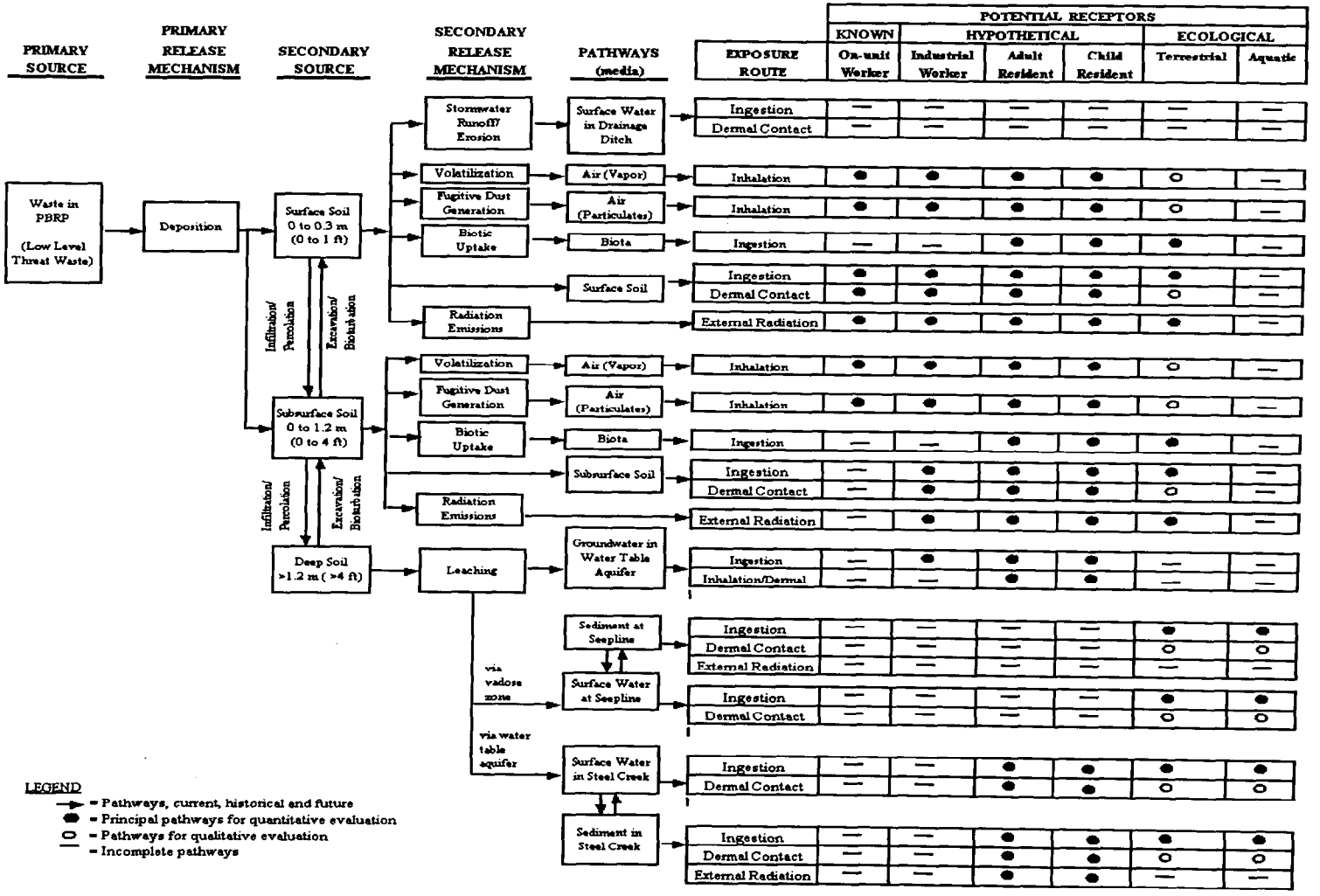

Figure 1. Example of Initial Pre-Workplan/Workplan CSM

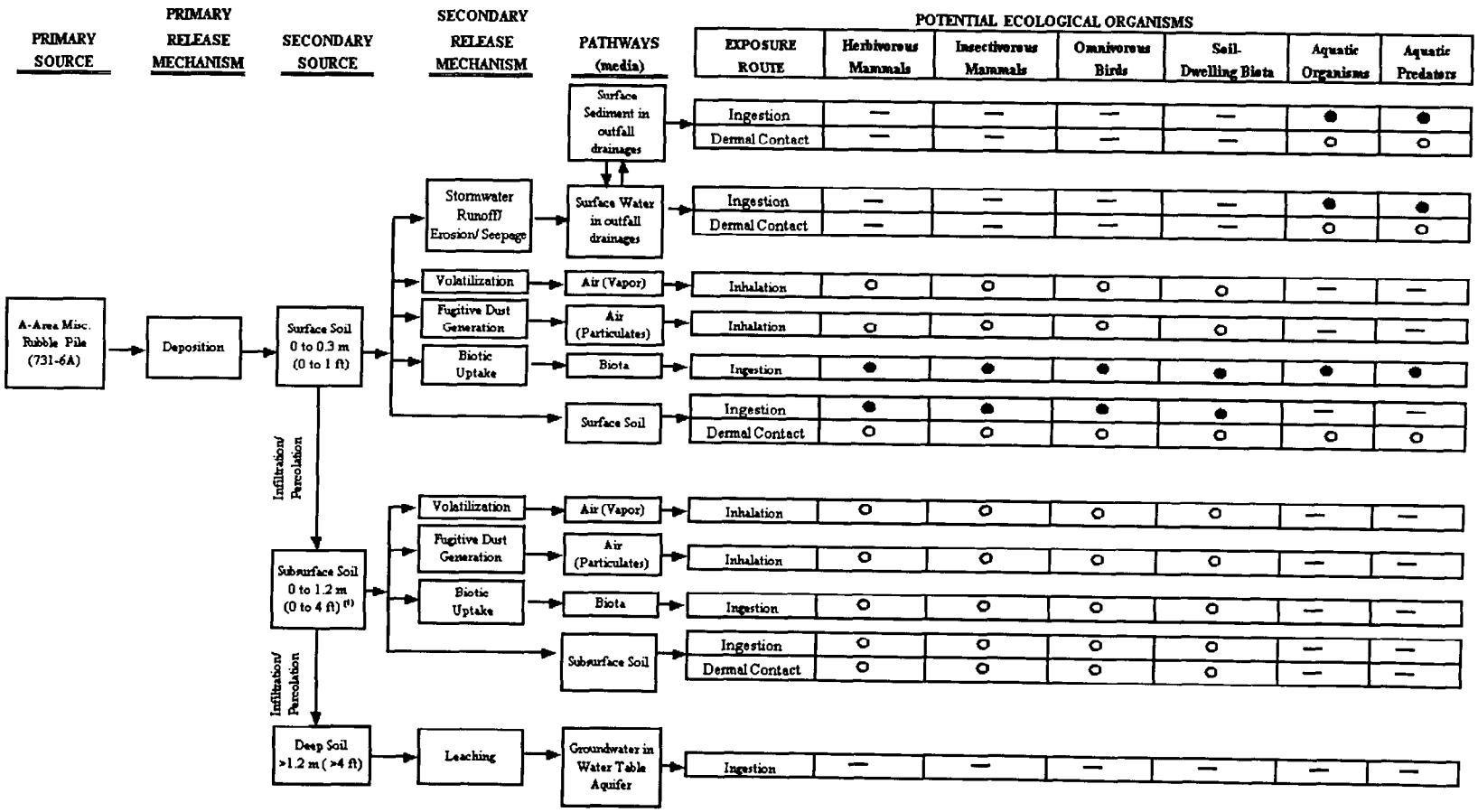

Figure 2. Example Figure of an Ecological Focused CSM

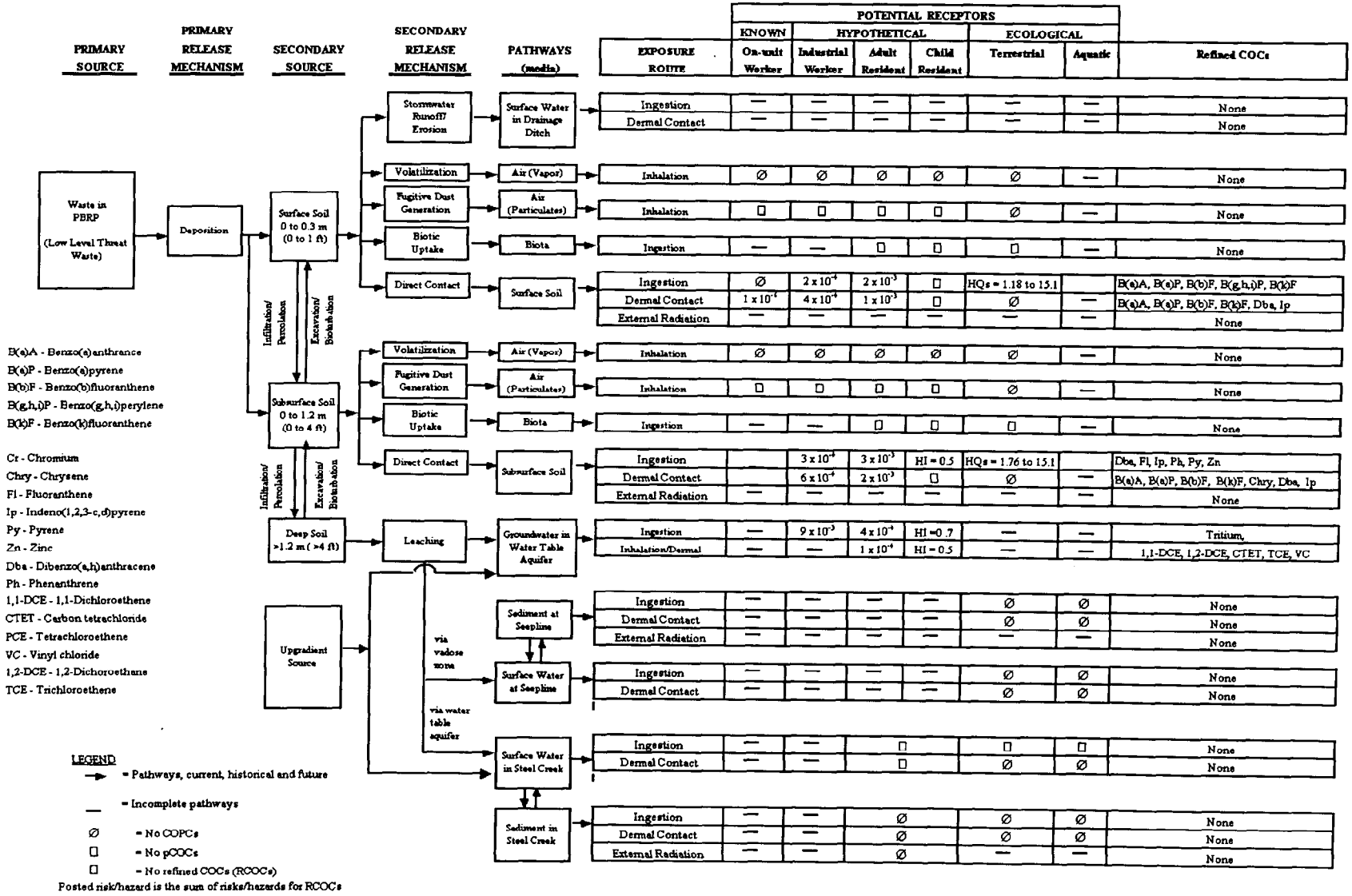

Figure 3. Example of Refined CSM